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Evolutionary SED diagnostics of starburst galaxies: signature of bimodality

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abstract We construct an evolutionary spectral energy distribution (SED) model of a starburst region, from the ultraviolet to submillimetre wavelengths. This model allows us to derive the star formation rate, optical depth by dust and apparent effective radius of starburst regions at various wavelengths; as a result, the intrinsic surface brightness of starburst regions can be derived. Using this SED model, we analyse 16 UV-selected starburst galaxies and 10 ultraluminous infrared galaxies. The derived star formation rates and optical depths are compared with emission line measurements and found to be consistent. The derived apparent effective radii are also consistent with observations. From the SED analysis, we find a bimodal property of the star formation rate with the optical depth and the compactness of stellar distributions. While mild starbursts have a limiting intrinsic surface brightness $L_{bol}r_e^{-2} \simeq 10^{12}$ $L_\odot$kpc^{-2}, intense starbursts tend to be more heavily obscured and concentrated within a characteristic scale of $r_e \simeq 0.3$ kpc. We suggest that the mild starbursts can be triggered by a self-gravitating disc instability in which feedback is effective in the shallow gravitational potential. On the other hand, the intense starbursts can be induced via an external dynamical perturbation like galaxy merging, in which feedback is less effective due to the deep gravitational potential attained by the large gas concentration within the central starburst region.